Interactive Multimedia Plane Geometry-Based Adobe Flash for PGSD Students

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Abstract

The Covid-19 pandemic has struck all parts of the world with huge impacts on all fields, including education. The education sector needs innovative learning media to adapt to the impact of this pandemic. The objective is to develop an Adobe Flash-based interactive multimedia of plane geometry that is feasible and effective as an answer to media innovation. This is categorized as developmental research using the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model. The subjects included 3rd-semester students of Elementary Teacher Education/*Pendidikan Guru Sekolah Dasar* (PGSD), the academic year of 2020/2021. The feasibility of Adobe flash-based media was assessed by media experts and content experts, while the effectiveness data were obtained from student learning evaluations. The results showed that Adobe Flash-based interactive multimedia of plane geometry scored 89.17% and categorized as 'very feasible' seen from the media aspect while from the content aspect, it scored 87%. Different learning outcomes were found before and after using the established media, which were 67.92 and 76.39 respectively. The significance test showed that the t-value = 6.353, greater than the t-table df (35) = 2.032, p <0.05. These results concluded that Adobe Flash-based learning media of plane geometry is feasible and effective in improving PGSD students' mathematics learning outcomes.

Keywords: interactive multimedia; plane geometry; *Adobe Flash*; learning outcomes; PGSD students

1. Introduction

Technology development, mainly in the field of learning media, is highly needed in today's era. 21st-century learning is characterized by the use of information technology and communication (Tamhankar et al., 2019). The learning process will be more effective and efficient when supported by technology, which results in the enhancement of the learning quality. One form of technology usage in learning is by utilizing technology as a learning medium. This is also supported by the fact that students are very familiar with gadgets and have high literacy of them (Larekeng et al., 2019). This condition encourages lecturers to develop innovations in learning by utilizing technology as a medium of learning. In line with this, Etcuban & Pantinople (2018) stated that the use of technology as a learning medium can make learning more effective. Elementary school mathematics learning based on the 2013 curriculum contains numbers, geometry, and data management (Setiawan, 2020), and PGSD Department's curriculum is developed based on the demands of elementary school education. It equips prospective elementary school teachers with special skills regarding primary school matters which include mathematics learning containing how prospective elementary school teachers learn to convey numbers, geometry, and data management (Mukminin et al., 2020).

Geometry learning for elementary school could contribute to the interests of students in learning mathematics, both for the formation of attitudes, mindsets, and for studying other sciences as well as everyday life (Mursalin, 2016). Given the importance of geometry, it is also essential for prospective elementary school teachers to master geometry learning. Elementary school teachers are required to be able to visualize geometric objects to their students and the visualization process requires learning media in its delivery.

The visualization process in learning remains to be limited to the use of images or concrete objects and worsened by the one-way learning, which is still applied broadly, resulting in a low student learning motivation and interest. This low input has a great contribution to the low learning outcomes (Phuntsho, 2018). For that reason, technology-based learning media is needed to visualize the concepts of plane geometry that could accommodate two-way learning. One choice of learning media that can be used is Adobe Flash-based interactive multimedia of plane geometry. The research on the development of interactive multimedia has been done several times such as Maryani's (2014) which developed an interactive CD of solid geometry using Macromedia Flash Player for IV-grade elementary students. Moreover, Nugraha & Muhtadi (2015) generated multimedia about the flat side of solid geometry for VIII-grade students of junior high school. Even so, the development of other geometric materials such as plane geometry, especially on the congruent topic, is still needed to support the research. Based on the explained description, there is a need for the development of mathematics learning media for PGSD students to interactively visualize the materials of plane geometry. Milovanović et al. (2013) argued that the use of interactive multimedia in learning geometry has a positive impact on student learning outcomes and participation. Therefore, the objective of this research is to produce an Adobe Flash-based interactive multimedia of plane geometry which is feasible and effective in improving mathematics learning outcomes of PGSD students.

2. Literature Review
Referring to Isjoni and Mohd Arif (2008: 85), there are six types of media used in learning, namely text, audio, visual, video, and human manipulative objects. The purpose of using media in learning is to facilitate communication and learning (Sutarto et al., 2021). Media functions for instructional purposes where the information contained in it must be able to encourage students both in mind, mental, and real activities so that the learning process occurs constructively (Azhar Arsyad, 1997).

According to Kemp and Dayton in Martinis Yamin (2007: 178-181), the benefits of media in learning activities are: Equalizing the delivery of subject matter; The learning process becomes more interesting; Possibility to reduce time study allotment; The student learning process becomes more interactive; Improving the quality of students; Flexibility to hold learning process (where and when); Improving students' positive attitudes towards learning materials and the learning process; The teacher's role can change to a more positive and productive way. Adobe-based interactive multimedia of plane geometry is a developed learning media containing text, sound, picture, animation, and video. Further, Nusir et al. (2012); Nuraini et al., (2019); Umanailo, (2019) stated that interactive multimedia comprising elements of the text, audio, animation, and video is supplementary media for an effective and efficient conventional learning process. Animation and pictures could create meaningful learning to facilitate students in understanding geometry concepts (Gambari et al., 2014). Moreover, Yilmaz & Argun (2018) mentioned that the visualization process possesses a vital role in geometry learning as student understanding of the concept relies on it, also, to strengthen student participation.

3. Methods
This is a research and development study employing the ADDIE model, which stands for five stages including (1) analysis, (2) design, (3) developments, (4) implementation, and (5) evaluation. The analysis stage covered the need analysis of Adobe Flash-based geometry learning media on PGSD students. It emphasized the lecture process and student characteristics as a reference in developing the desired media. In the design phase, researchers compiled a structural framework for the program content in the form of a storyboard. The development stage was filled with media creation done by taking pictures, recording, making animations, and compiling text. The next process was programming using authoring tools then continued to formatting and editing. Instrument and media validation was performed by experts (lecturers) in this stage to be tested in the next step, implementation. Furthermore, to obtain data on the media effectiveness, a learning evaluation was carried out in the form of testing. The last stage is evaluation, in which assessment was carried out to evaluate the developed learning media as a whole after being revised before dissemination. The research subject is 3rd-semester PGSD students of Universitas Negeri Semarang, the academic year of 2020/2021 numbering 36 people.

4. Data Collection

Data were collected through interviews, questionnaires, and tests. The instrument used was divided into two: (1) instrument of feasibility (assessment sheets used by the media and content experts, and questionnaires for lecturer and student response to the media); and (2) pre-and post-test to measure the effectiveness of the established media toward student learning outcomes.

The research data were analyzed using qualitative and quantitative techniques. A descriptive approach was applied to the qualitative analysis to present the results of need analysis. The data of media feasibility were converted from quantitative into five qualitative categories (Table 1).

Table 1. Criteria of Media Feasibility

Score range (in %)	Criteria
<21 %	Not Feasible
21 – 40 %	Less Feasible
41 – 60 %	Fair
61 – 80%	Feasible
81 -100%	Very Feasible

Quantitative data in the form of learning evaluation results were analyzed using dependent t-test statistical analysis.

5. Results and Discussion

The development of learning media tailored to the needs of students can make the learning process run optimally. The product produced in this study is Adobe Flash-based interactive multimedia of plane geometry consisting of three main parts; the opening, the core, and the closing part. The materials contained in the media are similarity and congruence. The opening section comprises the title, media development team, and institution. On the menu page, there are several buttons like Graduate Learning Outcomes/*Capaian Pembelajaran Lulusan* (CPL), Subject Learning Outcomes/*Capaian Pembelajaran Mata Kuliah* (CPMK), materials, practice items, and evaluation. The start page display of Adobe Flash-based interactive multimedia can be seen in Figure 1.

Figure 1. The Start Page Display of Adobe Flash-based Interactive Multimedia

The next part is the core section that presents the contents through menu buttons available on the homepage menu. The CPL button contains the learning outcomes of PGSD graduates while CPMK provides learning outcomes of the Elementary Mathematics course. The material menu consists of the similarity and congruence topic. The display of the content menu can be seen in Figure 2. The exercise items are designed to be done by students on the media which can be accessed via the menu button. Its interactive design allows students to work independently on their respective gadgets. They can immediately know the correct answers to the item they are working on by looking at the responses displayed by the media. To measure student understanding of the materials being studied, an evaluation menu is provided.

The last part of media is the closing section which is designed as a way out of the media. It contains a confirmation for media users to exit.
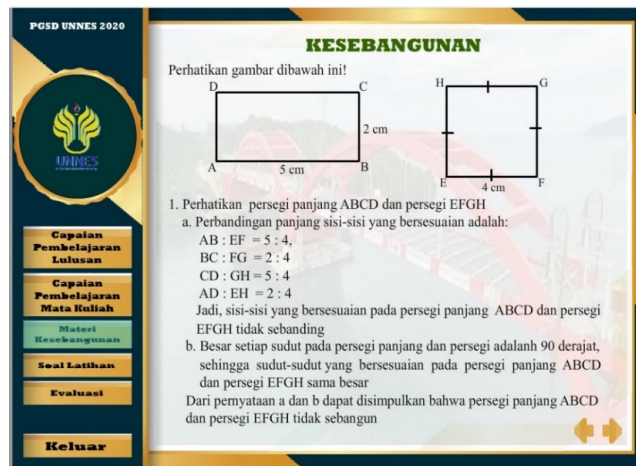

Figure 2. The Content Menu Display of Adobe Flash-based Interactive Multimedia

Before being tested to learning, the established media had to be examined for its feasibility, assessed by the media and content experts.

Assessment by media experts consists of two aspects: (1) display, which includes layout design, typography, images, animation, audio, video, and packaging; (2) programming, which includes packaging, usage, navigation, and interactive links. The following Table 2 presents the results of the media experts' assessment.

Tabel 2. Assessment Results by the Media Experts

No	Aspect	Component	Score	Category
1.	Display	Layout design	9	Very feasible
		Typography	14	Very feasible
		Image	14	Very feasible
		Animation	8	Feasible
		Audio	8	Feasible
		Video	8	Feasible
		Packaging	14	Very feasible
2.	Programming	Usage	14	Very feasible
		Navigation	9	Very feasible
		Interactive link	9	Very feasible
The total score for all aspects			107	Very feasible

Table 2 informs that the assessment results by media experts obtained a total score of 107. The score was converted into a percent (89.17%) and categorized as 'very feasible'. The Adobe Flash-based multimedia is declared feasible if the score exceeds 74 or above 61%. The Adobe Flash-based interactive multimedia of plane geometry was assessed based on five aspects including (1) validity, (2) significance, (3) learnability, (4) attractiveness, and (5) usefulness. Similar to the media experts' assessment, the content experts' assessment also has minimum eligibility criteria that must be met so that the developed media is appropriate for testing. The following table shows the content experts' assessment results of the interactive multimedia.

Table 3. The Content Experts' Assessment Results

No.	Aspect	Score	Category
1.	Validity	20	Feasible
2.	Significance	18	Very Feasible
3.	*Learnability*	27	Very Feasible
4.	Attractiveness	12	Feasible
5.	Usefulness	10	Very Feasible
	The total score for all aspects	87	Very Feasible

As seen from Table 3, the assessment score was 87% (87) and classified as 'very feasible' with a minimum score of 61 (61%). Therefore, it concludes that the content of Adobe flash-based interactive multimedia of plane geometry is declared 'very feasible'. Referring to the evaluation results from media and content experts, the established multimedia is feasible to be tested in learning. Nevertheless, some suggestions were proposed by the experts for media enhancement.

A. The Effectivity of Adobe Flash-Based Interactive Multimedia of Plane geometry
After being declared feasible by the experts, the developed interactive media was tested on PGSD students to reveal its effectiveness. The efficacy was derived from the average evaluation results of PGSD students' learning before and after using the developed media. The average results were tested using the dependent t-test which had previously been tested for data normality and homogeneity. The following Figure 3 presents the data of the average learning outcomes in Elementary Mathematics Learning course before and after using the Adobe flash-based interactive multimedia.
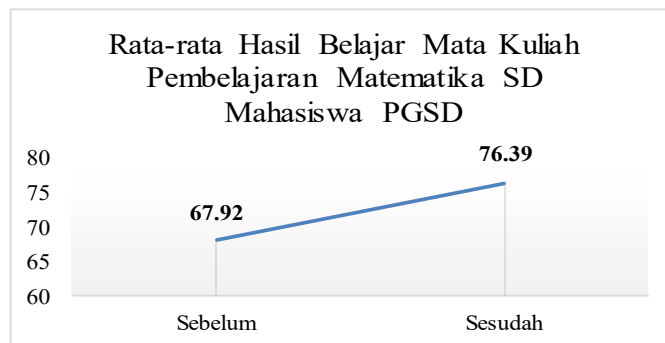

Rata-rata Hasil Belajar Mata Kuliah Pembelajaran Matematika SD Mahasiswa PGSD

Figure 3. PGSD Students' Average Learning Outcomes

The increase of student average learning outcomes is visible in Figure 3. After using the developed interactive multimedia, the students' average score escalated 8.47 points compared to the previous score. However, to unveil the significance of the increase in PGSD students' learning outcomes, a further test was carried out, i.e., the independent t-test. It is beneficial for knowing the significance between PGSD student learning outcomes before and after using the Adobe Flash-based interactive multimedia on the Elementary Mathematics Learning course. The following Table 4 displays the independent t-test results.

Table 4. The Results of Independent T-test on Student Learning Outcomes

The Tested Data	t-count	t-table (35), p < 0.05	Hypothesis	Information
PGSD students' average learning outcomes before and after applying the developed media	6,353	2,032	Ho is rejected if t count > t table	There is a significant difference

Table 4 informs that the results of the independent t-test had a t-count equals to 6.353 or bigger than the t-table. It means that there is a significant gap between the student score before and after using the Adobe Flash-based interactive multimedia on the Elementary Mathematics Learning course. Based on the presented data, it concludes that the use of the developed interactive media is effective in increasing PGSD students' learning outcomes.

The effectiveness of a learning process is influenced by several components. Felinda & Sugiyono (2018) mentioned seven learning elements including learning objective, content, method, model, strategy, media, and evaluation. Furthermore, Dolong (2016) explained that those learning components are interrelated one to another so the lecturer's role in integrating them is highly essential as it will impact successful classroom learning.

Media is one of the influential learning elements. Tafonao (2018) asserted that media is a stimulant of students' minds for effective learning processes. It is strengthened by Sainuddin & Taufiq (2016) that appropriate learning media is the key to efficient learning. This implies that determining, selecting, and developing a learning media must be done cautiously. Moreover, Umar (2014) explained that the selection of learning media should be adjusted to the needs of teachers and students so that its benefits can be directly experienced in learning. Besides, learning media development should accommodate the needs of students in learning, both from the objectives, student characteristics, and teaching materials (Abidin, 2016; Marpanaji et al., 2018).

The Adobe Flash-based interactive multimedia of plane geometry discusses the topic of similarity and congruence. The effectiveness of the media, which has been proven, is possibly happened due to several reasons. First, it contains some elements like text, image, audio, and video which have distinct functions each. Image and animation assist the students to understand the materials well as it requires visualization. This is supported by Prayito, Suryadi, & Mulyana (2019) stating that visualization plays a great role in student comprehension. Moreover, Yang et al. (2016) believed that the use of visual elements motivates students during the learning process. The other element, audio, could train students' listening skills which also influences their understanding (Widyaningrum, 2015). In line with this, Taylor & Clark (2010) mentioned that audio contributes to the increase of learning outcomes. Further, the combination of sound and display elements could accommodate students in processing information, increase the amount of information a learner can process, and generate effects of instruction using various stimuli (Hughes et al., 2019). All these positive deeds then make it easier for students to understand the materials being studied.

Second, the developed media is interactive. Paseleng & Arfiyani (2015) explained that there are four benefits of interactive media, they are (1) having various formats; (2) strengthening student active participation; (3) flexible learning process; (4) providing a more realistic learning experience. Parallel with this, Wiana (2018) also stated that the use of interactive media can make the learning process run more interesting, effective, and efficient because learners may carry out the learning process at any time and anywhere. These advantages could support the learning process to be more optimal as student motivation escalates (Ghofur & Youhanita, 2020). Good student learning motivation has a positive effect on student learning outcomes. Suarsana, Mahayukti, Sudarma, & Pujawan (2019) stated that the use of interactive media in learning mathematics effectively improves the learning outcomes.

6. Conclusion

Based on the discussion, it concludes that the Adobe Flash-based interactive multimedia of plane geometry has met the feasibility criteria based on the assessment results done by media and content experts. The developed interactive multimedia is also effective in improving PGSD student learning outcomes in the Elementary Mathematics Learning course on plane geometry topic. This has been proven by the significant increase of the learning outcomes before and after utilizing the media. The difference occurred as the student motivation escalated due to the multimedia's conveniences. In other words, the media is appropriate for wider usage by lecturers in teaching plane geometry to PGSD students, primarily for long-distance learning. Nevertheless, the development is limited and open for further research, which allows other researchers to

work on, for example, to discuss other topics in a mathematics course. Aside from that, further studies may be done to reveal the influence of the media not only from the cognitive but also affective and psychomotor aspects.

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